

BACKGROUND OF THE INVENTION

Fire fighting boats/ships are built to put out ship fires at sea or in harbour and may even be deployed to fight fires in buildings located along the seafront where access by land fire engines is limited. These vessels normally have deep draught that commensurate with its size and capability of the fire fighting systems and operations under high sea state conditions. There are also small fire fighting boats for use in rivers, lakes and other body of waters that are calm and relatively shallow. However, in all cases, these vessels need sufficient water under the keel to navigate safely and operate, and also for the fire pumps to suck in water and work properly. Typically, any water depth below 2 m will be a problem for even the smallest fire fighting boat. In shallow depths, sea debris and bottom mud can easily get sucked and block the intakes thus rendering both the ship operations as well as fire fighting systems useless.

There are situations where a boat is on fire after running aground on a reef and finds itself quickly on a dried out terrain especially in a gentle gradient seabed with a fast receding tide. When that happens, even small fire boats cannot get close enough for effective fire fighting because of the lack of water under the boat. Some fire fighting vessels carry a small dinghy to deal with shallow water situations. However, these boats also eventually run into shallow water difficulties as they use an outboard motor for propulsion. The firemen may then have to disembark from the dinghy and tread carefully on unknown terrain dragging the fire hose along over the remaining shallow waters with its unpredictable dangers. In some cases, the main fire fighting vessel and the vessel that is on fire may be separated by several hundred metres making it nearly impossible for the fire fighting vessel to do anything.

The present invention relates to the development of a remote controlled marine robot that is attached via the fire hose to the main fire fighting vessel and allows fire fighting to take place on a ship on fire regardless of the depth of water and even in a dried reef. This robot uses the high pressure water from the fire boat's fire pumps to provide the thrust needed for the robot to get to the boat on fire. The robot is carried onboard the fire fighting vessel and is merely an extension of the fire fighting vessel's capabilities by allowing water generated by that vessel's high pressure fire pumps to be used by the robot at a distance away. Fire fighters control the robot via wireless communications focusing on the direction of travel of the robot as it gets to the boat on fire. They then control the fire monitor to direct the water spray. Images from the Cameras on the robot provide the fire fighters with a clear view of the situation.

BRIEF DESCRIPTION OF THE INVENTION

The present invention relates to the creation of a remote controlled marine fire fighting robot that is attached to the main fire boat via a fire fighting hose. High pressure water from the main fire pump is used to provide the thrust force needed to propel the robot forward using the principle of a water jet. The water is directed backwards via two outlet ports at the stern of the robot thus providing the robot with its de facto own water jet system. By changing the pressure setting on the fireboat's fire pump, the robot's speed forward can be changed. Since the water providing the thrust is always coming from the fireboat, shallow water is never a concern. As the robot moves further away from the fire fighting vessel, the robot drags the fire hose with it and a higher pressure is set at the fireboat to provide a larger thrust with the increasing drag caused by the weight of the fire hose.

When the robot has moved onto dried out terrain, the robot's wheels will first make contact with the shallow seabed and then the ground. The remote controlled valve and nozzle unit is now set to direct water flow coming through the fire boat hose onto a internal paddle wheel. The force of the water on the paddle wheel causes it to turn which then turns the outside wheels of the robot to drive it over land/reef. The rate at which the robot now moves on land is dependent on the amount of force exerted on the paddle wheel.

When the robot arrives at the position needed for it to fight the fire, the valve and nozzle assembly is remotely changed to enable the water from the hose to be directed through the fire monitor nozzle onto the boat on fire. The operator on the mother vessel than controls the robot position and the fire monitor accordingly.

To alter the direction of the robot when it is traveling over water, the valve and nozzle assembly is adjusted such that a higher water flows occurs through one side of the jet and a reduced water flow occurs in the other outlet. The resulting differential pressure causes the robot to turn towards the side of lower water pressure. The adjustments in the valve and nozzle assembly will be done by software. The operator of the robot only needs to create a marker on the robot control screen that shows where the boat on fire is in order for the robot to self drive itself to the final point.

When the robot is moving over dry terrain/reef and moving on wheels, the alteration in heading of the robot will be by controlling the amount of water hitting the paddle wheel. To turn right, a strong force of water acts on the left side paddle wheel to move the left wheel more than on the right side. The control of the water is via the remote control valve and nozzle unit. The robot may be turned to go in the opposite direction by making a turn so that it can move back away from the boat on fire.

The fire fighting marine robot has a power pack in the form of a battery onboard to provide the power needed for the remote control valve and nozzle assembly to work. This power pack can be recharged by the water turning another internal paddle wheel in order to run a small alternator that will provide the charging current to the power pack.

To keep the entire fire fighting robot small and easy to handle, the base unit weight will comprise the fire monitor nozzle, the remote control valve and nozzle assembly and the power pack. The weight of this will be less than 25 kg which enables the robot vehicle to be easily man handled onboard the fire boat and moved around the deck. To enable the robot to work with the water supplied from the fire hose, the

weight of the robot is increased by adding augmented weight blocks to it just before launch. The weights will be secured into weight mounting racks on the robot frame. The all up weight of the robot will be about 100 kg.

The invention is adept to being used in correspondence with other compatible fire hose connectors so that there is commonality of parts and easy integration between the robot and its employment from the fire boat.

When the use of the robot for fire fighting is completed, the water in the hose is shut off at the fire boat to allow the robot to be manually recovered by simply pulling on the fire hose to get the robot back to the fireboat. It is also possible to turn the robot using the pressurized hose so that the final position of the robot is to get back to the mother ship.

For recovery of the robot onboard the mother ship, the augmented weights are first removed from the robot before the rest of the robot is pulled onboard via the recovery line.

DETAILED DESCRIPTION

General Unit Description The remote fire fighting robot comprises a hull body that is designed for good flotation to provide good stability in water. The hull form is also designed to help the robot keep to a straight path as it is pushed through the water. There are two buoyant wheels on either side of the robot body that provide extra stability. These wheels will also provide the robot mobility when it hits land and can no longer move using just the reverse thrust from the hose. The fire monitor sits on top of the robot. A fire hose attachment is located at the rear of the robot. This attaches the fire hose from the fireboat's fire pump. The fire hoses are normal hoses that are available onboard and can be extended by normal hose couplings. The robot body has a frame that allows augmented weights to be added to it and secured so as to increase the weight of the robot unit for it to work successfully with the thrust provided through the fire hose.

A remote controlled valve and nozzle unit is the control centre electronics of the robot. It enables the water from the fire hose to be directed into different channels to achieve different effects. It allows water to be discharged at the back of the robot, thus providing the thrust to move forward. That water can be diverted to jet onto internal wheel paddles that turn the outer wheels to propel the robot on dry terrain. The nozzle unit also controls the amount of water that falls on one or both sides of the paddle so as to turn the wheels of the robot to a different direction on dry terrain. This allows the robot to point the fire monitor at the intended direction for the water spray to land on the right place of the boat on fire. The unit also directs the water to the fire monitor to fight the fire.

LED lights are installed on the robot to provide the floodlighting of the boat on fire to enable the fireboat to clearly see the situation. A day camera is also installed to provide the imagery that is sent to the fireboat for on scene management. A wireless radio enables the communications from the fireboat to the robot. This radio also provides for the camera's images to be sent back to the fireboat.

A power pack comprising mainly a 12V 80AH battery provides the power needed to control the robot's nozzle unit and the wireless radio. By using the battery solely to control actuators in the robot ensures that the robot has adequate electrical power for control purposes for the duration of the fire fighting.

Fig 1 shows the perspective view from the front of the remote controlled marine robot unit. The robot hull is specially designed to be highly stable even when pushed from behind by a water jet while dragging along a water hose filled with water and resting on the seabed. The robot hull is designed especially for shallow water operations while keeping the platform in a straight line as much as possible without the need to control the differential thrust at the outlets.

Fig 2 shows the perspective view of the robot as seen from the rear. The fire hose from the fire fighting vessel is coupled to the robot at the rear via standard fire fighting quick twist and lock hose connectors. Twin water outlet ports are shown that provide for the water jet that causes the robot to move forward when high pressure water is put into the hose.

Fig 3 shows the robot side perspective. In that view the Rotary Valve is remotely controlled to turn until the water from the fire hose is connected directly to the fire monitor. The Rotary Valve is designed to match the water inlet diameter so as to minimize pressure drop of the water from the fire hose and enable maximum flow.

Fig 4 shows the specially designed Rotary Valve which has two openings on the side. The openings at the side are sized to be of the same diameter as the fire hose to ensure smooth water flow. At any time, only one of these openings are connected to the fire hose like a bullet chamber in a revolver gun. Opening 1 allows water to pass into the fire monitor. Opening 2 causes water to flow into two separate channels on either side of the Valve. The water emerges from the ports at the aft of the hull of the robot producing thrust. This thrust pushes the robot forward. When Opening 2 is in use, water also can flow forward as a jet to rotate the wheel of the robot to enable the robot to move on land.

To change from Opening 1 to Opening 2 or vice versa, the Rotary Valve is turned 180 degrees on a spindle that is connected to a gear system that is in turn activated via an electronic control system.

Fig 5 shows the frontal perspective of the Rotary Valve and the two Opening as well as the water channels in the port, one of which leads water to the aft ports of the robot to provide thrust and the other which connects to the fire monitor.

Fig 6 shows the side perspective of the Robot and highlights that the Rotary Valve is now set up for the robot to be propelled using the fire hose water as a water jet.

Fig 7 shows the water vane that rotates when the water from the fire hose is pushed through a nozzle and lands on the vane. The water vane is connected to an external wheel located on the side of the robot hull. When the vane turns the wheel is also turned thus enabling the robot to move on the ground using the wheels as the sole means of movement. The water that passes through the nozzle is controlled in intensity using a valve controller. In this way, the amount of water falling on either side of the vanes is different and the difference results in one of the wheels moving faster than the other and therefore causing a turning movement and a change in the heading of the robot.

Fig 8 shows that after the robot is in position and does not need to move soon, the wheels are locked and a remotely controlled brake extends from the rear of the robot and acts against the ground in order to prevent the robot from being pushed backwards by the thrust from the water leaving the fire monitor.

The Remote Control Unit determines whether the robot moves forward using water jet, wheels or stays in position while the robot conducts fire fighting.

CLAIMS

1. A remote controlled marine fire fighting robot that is capable of conducting fire fighting at sea in very shallow waters and when the robot is on land. The fire fighting is achieved via water coming out of a commercial standard electronically controlled fire monitor which can be controlled in elevation and direction as well as the type of spray.
2. The robot in Claim 1 uses high pressure water from a fire hose that is connected to a high pressure fire pump located onboard the mother fire fighting vessel. The high pressure water functions like a water jet to push the robot laterally when it is moving through water as well as when the robot reaches dried out terrain.
3. The hull is designed with a special form such that when it is being pushed through the water as in Claim 2, the hull generally stays in a straight path unless the direction of the robot is deliberately altered.
4. A unique rotary valve assembly that enables the incoming water that comes from the hose to be directed either for propulsion purposes as in Claim 2 or to the fire monitor for fire fighting as in Claim 1. This rotary valve is rotated via a mechanism that is based on electrical signals.
5. As the robot travels to the boat on fire, it needs to alter its heading to stay on track. This is done by varying the amount of water flowing from the two outlets at the back of the robot. This water variation is again achieved with the rotary valve in Claim 4 which rotates often to change the quantity of water flowing to each outlet. The different flows create differential pressure that causes the robot body to turn to point the robot body in the desired direction.
6. A special wheel designed for rough terrain that provides both buoyancy and traction for the robot as it moves from floating on water to being on dry land respectively. This special wheel is turned using high pressure water directed at a wheel driving mechanism. By changing the intensity of the water that acts on the wheel driving mechanism, one wheel may turn faster than the other wheel resulting in an alteration of the direction of the robot as it moves.
7. A layout of interconnected piping and nozzles in Claim 1 that is arranged to optimize the flow of water from Claim 2, Claim 4 and Claim 6.
8. Augmented weights are placed into the body of the robot in Claim 1 to achieve the desired weight for the purpose of using the means in Claim 2 for propulsion. This enables the Claim 1 to be designed for easy handling by one person even without the use of an assisted device such as a crane.
9. The devices in Claim 4, Claim 5 and Claim 7 are controlled via special software that enables the robot in Claim 1 to move to the desired position on its own without operator intervention. The software determines the amount of rudder movement and the instances when this movement is to take place bearing in mind the speed of the robot and its relative position to the end point.